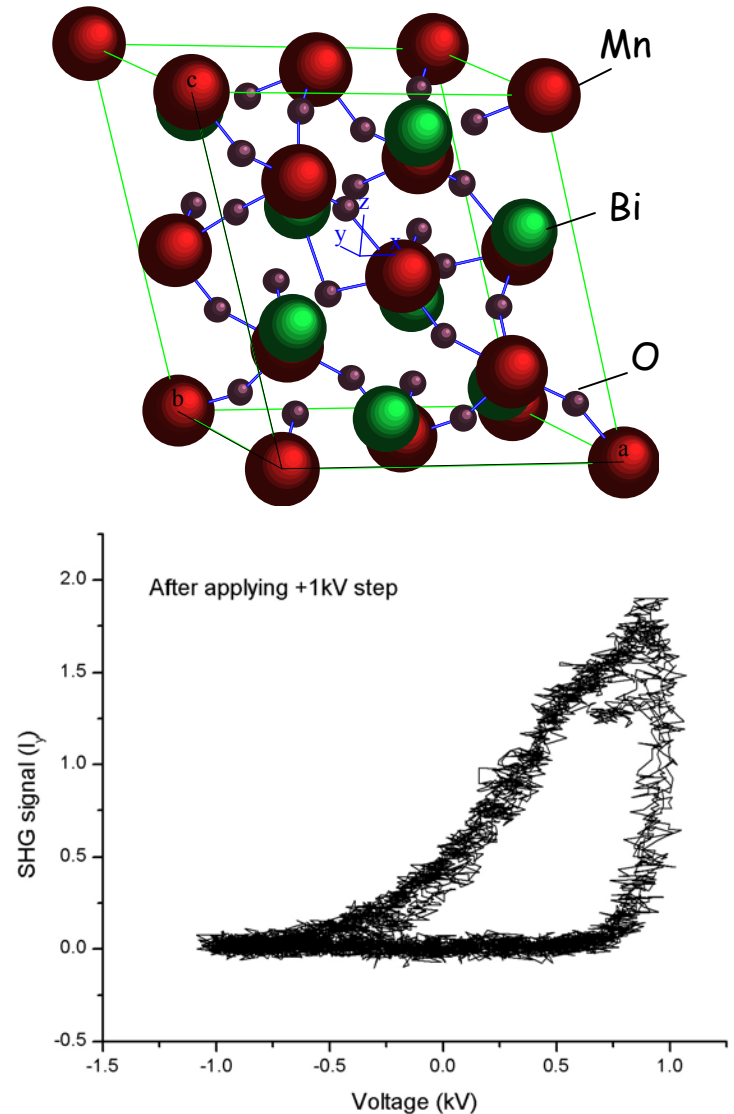


# Ferroelectric-Ferromagnetism and Giant Nonlinear Optical Responses in $\text{BiMnO}_3$

Venkatraman Gopalan, Pennsylvania State University, NSF-CAREER, DMR-9984691

Bismuth Manganite is the simplest material predicted (Hill, 1999) to possess *both* ferroelectricity and ferromagnetism. Ferromagnetism is seen below 105K. Ferroelectricity has been difficult to prove electrically. We have discovered strong evidence for ferroelectricity using optical second harmonic generation (SHG) measurements, as seen from an asymmetric hysteretic behavior of SHG signal with external fields (bottom) arising from ferroelectric domain rearrangement. We have also discovered giant second and third order optical nonlinearities. Potential applications include both magnetic and electrical data storage in one medium, controlling ferromagnetic resonance devices using electric fields and vice versa, and all-optical modulation devices.

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# Real-time studies of Domain Dynamics in Ferroelectrics for Photonics

Venkatraman Gopalan, Pennsylvania State University, DMR-9984691

## Education

Two undergraduate students (David Comstock, Luisa Soaterna), three graduate students (Sungwon Kim, David Scrymgeour, Lili Tian), and one Post-doctoral scholar (Alok Sharan) contributed to this work. One student (Kim) received his Ph.D in June 2003. One student, Scrymgeour, is an NSF graduate fellow. Luisa Soaterna received McNair summer research fellowship for minority students, and performed summer research on the design and demonstration of an electro-optic switch based on ferroelectric domains. Luisa is a major in physics and math from U. Virginia State U., and is applying to graduate school in Biophotonics. David Comstock performed his senior thesis on electro-optic devices, and is currently a graduate student in northwestern university.



Graduate student Lili Tian, instructing undergraduate student, Luisa Soaterna, on the photolithography tool inside the clean room. (Summer 2003).